

Emerald Ash Borer

Michigan Eradication Strategy



May 2003



Michigan Department of Agriculture
Michigan Department Natural Resources
Michigan State University
U.S. Department of Agriculture

For more information, visit the Emerald Ash Borer web site at www.emeraldashborer.info or the Michigan Department of Agriculture web site at www.michigan.gov/mda, key word "ash borer."

Emerald Ash Borer Toll-Free Hotline: 866/325-0023
MDA Executive Office: 517/373-1052

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To report a potential EAB infestation:

Emerald Ash Borer Hotline: 866/325-0023

- b. Planning a Community Planting: A workshop which outlines strategies for organizing a community (volunteer-driven) planting should be offered to municipalities and community based organizations as a means of encouraging them to maximize replanting dollars *and* community investment in replanting by hosting at least one community planting as part of the restoration strategy.
 - c. Planting 101: An on-site training to be provided to planting volunteers on planting day. Volunteers receive training in planting techniques at the start of each community planting project. On-site training is reinforced by trained planting coordinators who do quality control on each tree as it is being planted.
 - d. Maintenance/Follow-Up: Each planting partner will be asked to enter into a maintenance agreement. The commitments should be followed up each spring with PSAs and a direct mail piece designed to remind everyone who has received a tree to take care of it.
 - e. Data Management: The success of this strategy will depend in large part upon the data management processes in place. Sponsors of large-scale planting projects will need to track the location, species, follow-up and survivability data for all trees planted. Likewise planting committees will need to utilize neighborhood survey data in support of planting decisions.
7. Coordination of Resources: The restoration component of the plan will coordinate with existing available funding entities to supplement EAB restoration resources. Following are examples of funding or technical assistance options:
- Transportation Enhancement Act 21 funding
 - Forest Land Enhancement Program (FLEP)*
 - Americorps
 - National Urban and Community Forestry Advisory Council
 - American Forests – Global Releaf campaign
 - Tree Trust
 - National Arbor Day Foundation
 - Corporate Interests
 - Utilities
 - Consumer buy-in
 - Volunteers**
- * Forest Lands Enhancement Program: This is a new program included in the 2002-2006 Farm Bill. It is designed to provide: a) cost share assistance to private landowners for certain management activities, and, b) outreach and education opportunities to private landowners. The important difference in this new program is that each state has the flexibility to identify those issues that are the most important to its residents. The FLEP priority plan for Michigan is currently being developed by the Forest Stewardship Program coordinator in the DNR, and it appears that insects/disease problems will be one of the top priorities.
- ** Volunteers: MSU Extension’s Master Gardener Program is an example of a pool of qualified volunteers to help educate landowners on appropriate tree species, planting techniques, and long-term maintenance. Other volunteer restoration entities exist to promote green space and community beautification. These volunteers will provide necessary labor for installation and subsequent maintenance of young trees.
8. Evaluation: To ensure the short-term and long-term success of restoration efforts, it will be necessary to conduct an assessment of the operations the area of education, planting and maintenance.

Introduction

The Emerald Ash Borer (EAB), *Agrilus planipennis* (family Buprestidae), is an exotic foreign pest of ash trees in the U.S. It was first found in June of 2002 in Southeast Michigan, though it is thought to have been introduced into Michigan as early as five or more years ago. This borer is indigenous to Asia and is known to occur in China, Korea, Japan, Mongolia, the Russian Far East, and Taiwan. This pest is a significant economic threat to the ash resource in the entire North American continent. Preliminary findings by USDA Forest Service’s National Urban Forests stated, “the estimated potential national impact of *A. planipennis* is a loss of between 0.5% - 2% of total leaf area and a value loss of between \$20-60 billion.” Damage to ash trees in the landscape and wood lots in Southeast Michigan over the past five years is estimated at \$11.6 million. In addition to these losses, there has been an estimated \$2 million of nursery stock restricted from sale due to the infestation of the Emerald Ash Borer. Not reflected here are the impacts to the nursery industry from the loss of market, replacement of dying ash that are still under guarantee, and the social impact of the total destruction of ash in urban neighborhoods where every street tree in entire subdivisions has been removed.

The State of Michigan has implemented a quarantine to include the counties of Macomb, Oakland, Livingston, Washtenaw, Wayne and Monroe. This quarantine is designed to prevent the artificial spread of this pest while eradication plans are formulated and executed. The rulemaking process toward establishing a domestic federal quarantine and foreign import quarantine has been initiated. The pest has also been identified in the Windsor area of Essex County (Ontario Province), Canada, an area adjacent to Wayne County, Michigan. The Canadian Food Inspection Agency (CFIA) has quarantined the infested portion of Essex County and enacted regulations (Ministerial Order) restricting movement of regulated material outside their regulated area. EAB has also been confirmed in Lucas County Ohio, where control efforts are now underway. Additionally, CFIA plans to establish a directive restricting the foreign importation of EAB host materials. There is a working partnership between the Canadian and the U.S. response entities, to assure an effective, coordinated eradication program.

Because ash trees are medium to fast growing trees tolerant of urban environments, and because ash have been shown to be resistant to gypsy moth, this species has been extensively used as street trees and in the home landscape in Southeast Michigan. Unlike the experience with gypsy moth, which defoliated but rarely killed trees, the EAB has killed trees that were otherwise in vigorous condition. In addition to its value in the landscape, there is an estimated 18.5 million board feet of ash timber harvested annually from hardwood stands in Michigan. Because EAB is an exotic pest to the U. S., there are no known natural predators nor are there proven chemical or cultural options, other than tree removal,



available to control EAB. It is expected that left unchecked, EAB will continue to infest and destroy the native and landscape ash resource, resulting in millions of dollars of loss to lumber and nursery markets, in addition to what may be an even larger cost of removal, disposal, and replanting of communities suffering the loss of their ash species.



Summer photo of *Fraxinus* killed by *Agrilus planipennis*.



Neighborhood photo after removal of *Fraxinus* street trees .

Considerable work has already been done through collaborative efforts by the Michigan Department of Agriculture (MDA); Michigan Department of Natural Resources (MDNR); USDA Forest Service (FS) and Animal and Plant Health Inspection Service (APHIS); and Michigan State University (MSU). In addition, many other agencies, industry groups, associations and universities, including the National Plant Board (NPB), the Michigan Nursery and Landscape Association (MNLA), the American Nursery and Landscape Association (ANLA), and Michigan Technological University (MTU) have responded. Present efforts have been mobilized largely out of existing resources at the expense of other ongoing programs. The devastating impact on ash trees has already had a significant economic impact and must be addressed immediately, with adequate resources, to prevent irreversible damage to an essential segment of the nursery and forest industries on this continent. Containment of EAB and its ultimate eradication will require immediate action in areas of quarantine containment, disposal of infested trees, survey, outreach and education, research, and restoration.

The purpose of this plan is to provide a means to address EAB and its associated risk, in order to reduce the economic and environmental impacts resulting from EAB infestation, by identification and implementation of measures necessary to eradicate this invasive insect pest. While a redirection of resources has already been made by all responding agencies and universities, resources are inadequate to address this monumental pest problem in a holistic and timely fashion. Immediate needs include the following components:

- Quarantine Enforcement
- Survey
- EAB Control Strategies
- Data Management
- Outreach and Education
- Research
- Restoration

The estimated cost of this response is included at the end of this document. The financial support and successful implementation of an effective eradication program for EAB will protect the nation’s ash resources and its availability for the nursery industry.

A. Restoration in the EAB Management Strategies:

Restoration is an integral component of the EAB zone management strategies that call for mandatory host tree removals. Restoration is also included as a plan component where incentives are called for to encourage voluntary actions, such as removal of host trees in specific areas of the Firebreak Zone, in the case where the management of the zone calls for reduction in host material in the identified areas. In general, the timing for restoration activities related to the zone management strategies will be ‘immediate’, whereas the timeline for restoration activities within the Core Zone will begin now and continue for many years to effectuate the objective of a healthy, diverse, forest ecosystem.

B. Restoration Activities:

1. Development of an Approved Replacement Planting List: Complement EAB host preference research activities with the immediate development of necessary planting trials to identify additional tree species as alternatives to *Fraxinus* in the area of EAB impact. Utilize information already known to provide immediate lists of alternative species for distribution to the public in ongoing campaigns. Alternative species listings need to provide information on maximum/minimum sizes for species as it impacts selection for specific sites in addition to the relative availability of the species.
2. EAB Symposium for Professionals: Provide a one-day workshop for elected and appointed officials, city foresters, and tree care professionals, to share information on the program parameters and how to participate.
3. Coordination of Restoration Activities with Municipalities: Restoration activities that relate to municipal plantings must coordinate and be assured that the municipality has the resources in place to maintain the trees once planted.
4. Neighborhood Campaigns: An outreach campaign within affected neighborhoods will be implemented to provide regional Q&A sessions which can be followed by smaller community meetings and person to person contact through various partners in the program. The information provided at these sessions will: 1) reinforce the need for a healthy, diverse urban forest, 2) educate citizens about replanting opportunities, and, 3) provide information on what to expect during the containment, sanitation and subsequent restoration efforts.
5. Specific Campaigns Related to Mandatory and Incentive Based Tree Removals: In the case where the EAB eradication strategies include mandatory host tree removals, and where incentive programs are offered for host tree removal, the restoration component of the EAB eradication effort will coordinate with the control component. Where implemented, the host tree removal strategies will include information to subject property owners on how they can gain immediate access the restoration program. Specific procedures for tree replacement by voucher or other method need to be developed and implemented.
6. Overall Restoration Campaign Strategies: Prior to the beginning of any restoration plantings by non professionals, education will be needed to guide selection of tree species (“right tree in the right place”), train community based organizations on how to organize a volunteer-driven community planting, and train citizens and volunteers for community planting activities. Following are elements of these strategies:
 - a. Species Selection Information: Should be created for the benefit of Municipal Foresters. This information should also be available in a less technical, more accessible format for individuals replacing yard trees.

- 3. **Wildlife:** Evaluate potential impacts on wildlife habitat and individual species.
- 4. **Social:** Identify and evaluate societal concerns and impacts of *A. planipennis* management activities.

Needs and benefits: There is obviously a great need to obtain quantifiable estimates of the economic impacts of *A. planipennis* in the currently infested area, its potential impact on a state and region-wide scale, and how continued spread of *A. planipennis* could affect northeastern forests as a whole. Such an assessment will need to consider costs and benefits of *A. planipennis* on selected industries, such as tree care and landscape firms, nurseries, and forest products. The short- and long-term effects of widespread ash mortality must be compared with costs of implementing activities to manage, contain or eradicate *A. planipennis*.

Effects of *A. planipennis* on ash decline and mortality and a merchantable volume loss over time in forest settings will need to be monitored. Even in the short term, significant ash mortality could require substantial revisions in growth-and-yield models and productivity estimates in stands where ash is a dominant species. Information will also be needed to predict how forest productivity, species composition and stand structure will change over time, and the effects of widespread ash mortality on nutrient cycling and other ecological processes.

Data is needed on wildlife utilization of live, declining and dead ash. Wildlife species likely to be affected if the *A. planipennis* infestation expands should be identified and monitored over time.

From a social perspective, the current *A. planipennis* infestation occurs in a highly urban area comprised of neighborhoods ranging from very wealthy to very poor. An opportunity exists to assess variability in concerns and attitudes towards *A. planipennis* and management activities. For example, interest and ability to destroy infested trees or to protect shade trees with insecticides is likely to vary among municipalities, which could affect the success of the *A. planipennis* eradication strategy. Information related to sociological issues could also help to refine *A. planipennis* education and public awareness programs.

VIII. EAB Management Plan: Restoration

The process of restoration in conjunction with strategic tree removal for population management in the zone management strategies, coupled with the need to respond in the wake of EAB induced mortality and decline in the Core Zone, makes restoration a necessary component of the national EAB eradication plan. Following are the needs, implementation strategies, and goals of an EAB Restoration Plan.

The term *restoration* is meant to include; replanting with an approved non-host tree species; tree care and value education; follow-up maintenance and care of newly planted trees (3-year); and monitoring and evaluation. Ultimately, restoration activities will result in a well-managed, healthy and diverse urban forest.

Needs and benefits: Restoration is critical to the long-term strategy of creating a healthy, pest- and disease-resistant forest resource - - a diverse resource that is resistant to the EAB and other currently significant or future forest pests. Restoration is a critical issue with the publics affected by EAB, and is a necessary component of a successful EAB eradication strategy. Tree removal for population management efforts will be less problematic if a plan is in place for replacing the trees lost in the eradication/containment effort.



Adult *Agrilus planipennis*



Larva *Agrilus planipennis*



“D” Shaped Emergence Hole *Agrilus planipennis*



Serpentine Galleries *Agrilus planipennis*

Pest Eradication Through Zone Management Strategy:

Recognizing there is no precedent for combating an invasive beetle such as Emerald Ash Borer, and that effective control measures for this wood boring pest are not readily available, the agencies referenced earlier in this report are implementing a pest eradication strategy that establishes five distinct management zones. The purpose of the zone management strategy is to provide for detection, containment, and, ultimately, eradication of EAB. The above listed components will be modified for each zone in order to meet the management objectives of that zone. The five zones are described in further detail in the following paragraphs and include: core zone, suppression zone, fire-break zone, survey detection zone, and the targeted survey zone. The overall eradication strategy will also rely on continued use of existing surveys such as Forest Inventory Analysis, Forest Health Monitoring, CAPS (Cooperative Agricultural Pest Survey) survey for exotic woodborers, and other related surveys in forested areas for the detection of EAB or infested host trees.

Core (known-infested) Zone Activities:

The core zone represents the area known to be infested by EAB. Because of the large size of the infested area (approximately 2,400 square miles), control options are not feasible; therefore, the goal within this zone is to allow pest populations to exhaust their food resource within the zone, causing the pest populations to crash and effectively be eliminated.

A state quarantine has been enacted making it illegal to move ash wood products, such as nursery stock, lumber, or bark chips, out of a six-county area unless the products can be certified as EAB free through a thorough examination and treatment of all regulated articles. In the near future an internal quarantine will complement the expected federal quarantine and will prohibit the movement of regulated ash materials outside the core zone. A certificate of inspection issued by the regulatory authority must accompany the regulated articles, detailing conditions or treatments administered in accordance with approved methods. Regulatory enforcement in this area will include monitoring quarantine compliance and ensuring proper disposal of infested material. Because of the size of the infested area, it is imperative to work closely with many local units of government. In addition, there is a continuing partnership with the Canadian Food Inspection Agency (CFIA) to harmonize regulatory activities to effect the eradication of EAB.

Core zone activities include survey by visual identification of EAB symptoms such as any life stage of EAB, D-shaped holes, vertical-splitting bark, and serpentine galleries. Systematic surveys will be conducted to monitor the condition of EAB pest populations and the ash resource within the core zone. Such surveys will target the potential for resistant ash trees and monitor for possibility of EAB moving to alternate host trees.

An outreach and education strategy has begun, targeting property owners, to reduce the artificial spread of EAB. A “Don’t Move the Firewood” campaign has been instituted. Proper disposal of infested ash tree materials is very important in the core zone as it relates to quarantine compliance by controlling the disposal of infested ash tree materials. Dead and dying ash trees cut as a result of the EAB infestation in all zones will be collected in marshaling yards in the core zone, where a grinder will render the material to chips for transport and ultimate disposal by incineration or other approved method. The disposal of ash chips will primarily focus on incineration for the production of electricity. The core zone will also be utilized as a location for significant research activities, including EAB survivability in wood chips, the effectiveness of pesticides for control of EAB populations, and basic biology of EAB among others. Data, such as the number of infested trees destroyed, number and type of trees replanted, and information about pest populations will be collected in this zone. Because this is the largest zone of infested trees, it is important to follow tree disposal with restoration efforts to plant and maintain diverse, approved, non-host tree species in this zone. Ultimately, restoration activities in all of the zones will result in a well-managed, healthy, and diverse urban forest.

Generalist predators, including woodpeckers and sand wasps, have already been observed preying on *A. planipennis*. Other predators including clerids and staphylinids have been recovered from infested trees or bolts and may be attacking *A. planipennis* larvae. Several native parasitoids attack native *A. bilineatus* and *A. anxius* beetles in this region. These parasitoids may function as habitat rather than host specialists and could presumably expand their host range to include *A. planipennis*. Preliminary observations indicate that at least a few *A. planipennis* larvae have been attacked by hymenopterous parasitoids. If native insect predators or parasitoids of *A. planipennis* are identified, methods to attract or conserve these species, or rearing and augmentative releases could be considered.

No entomopathogens of *A. planipennis* have been identified to-date, although two fungal strains have been isolated from *A. planipennis* larvae in preliminary studies. Laboratory bioassays with native or naturalized entomopathogenic fungi could be valuable and could eventually provide options for protecting forest and urban forest trees.

It would be useful to acquire information about the identity and importance of specialist predators, parasitoids and pathogens of *A. planipennis* or closely related species in Asia.

G. Insect-Host Interactions:

- 1. Progression of External Symptoms of Infested Trees:** Document progression of bark splits, foliar discoloration, canopy die-back and epicormic sprouts.
- 2. Wound Response/Callus Formation:** Determine influence of tree species, size, age and vigor on callus formation.
- 3. Secondary Tree Pathogens:** Identify pathogen species, assess frequency of occurrence and virulence.

Needs and benefits: The progression and symptoms associated with *A. planipennis* infestation and the rate at which trees of different age, size and vigor succumb to attack should be documented. It will be important to determine if these patterns are consistent among ash varieties and species. Such information is critical for detection surveys, monitoring *A. planipennis* populations and predicting impacts.

In a few instances, young ash trees successfully defended *A. planipennis* attacks by callusing over larvae. More knowledge about this process, its frequency, timing and the level of tree vigor (e.g., moisture stress, carbohydrate reserves) associated with callus formation is needed.

On some trees, discolored tissue is apparent around the *A. planipennis* larval gallery. The discoloration may reflect secondary infection by *Nectria* sp., *Verticillium* sp. or other pathogens. Information is needed to determine: (a) how these pathogens influence tree mortality, (b) whether they affect larval survival, and (c) whether *A. planipennis* is functioning as a vector of native or exotic microorganisms.

H. Impact Assessment:

- 1. Economic:** Existing and potential economic impacts of *A. planipennis* at local, state and national scales; costs and benefits of management; economic winners and losers.
- 2. Ash Forest Resource at Risk:** Potential effects of *A. planipennis* on forest productivity, volume, tree species composition and regeneration.

E. Origin and Epidemiology:

- 1. **Epidemiology and Spread:** Identify origin of current infestation, determine rate and direction of spread to date, and predict expansion of infestation over time.
- 2. **Genetics and Systematics:** Similarity between North American & Asian populations.

Needs and benefits: Integrating intensive dendrochronology and related empirical data with population growth and spread models should provide a means to identify the area where *A. planipennis* first became established, determine the rate of spread of the current infestation, and to predict the rate and spread of the infestation over time. Aerobiologists have successfully modeled the dispersion of insects using meteorological models and data, coupled with simple models of insect flight behavior. This type of study could be used to examine how adults disperse when exposed to a variety of environmental stimuli, yielding information on beetle transport distances and locations of deposition. The same meteorological models could be applied to evaluate transport and distribution of kairomones, providing information related to remote detection of potential host trees by adult beetles. Results from *A. planipennis* and chemical transport research could be combined with dendrochronological studies and modeling results to describe the epidemiology and spread of EAB. This information will help to prioritize detection and survey efforts and to assess current and potential impacts of *A. planipennis*. Results will also be very important in evaluating and documenting the effectiveness and benefits of the *A. planipennis* eradication program over time.

Taxonomic descriptions of adult *A. planipennis* and *A. marcopoli* consistently refer to coppery colored eyes while the *A. planipennis* beetles in North America seem to have black eyes. Although this morphological variation is of little importance by itself, it does suggest the presence of a founder effect. Such a genetic bottleneck has been shown to result in behavioral or ecological changes that make the invasive population function differently than populations of the species in its native land (Argentine ant for example). Genetic comparisons of North American and Asian populations could provide valuable data about the origin of the beetle and how it may be expected to function here.

F. Natural Enemies and Biological Control:

- 1. **Identify Native Natural Enemies that Attack *A. planipennis*:** Characterize phenology and stage-specific mortality rates.
- 2. **Attraction, Enhancement or Augmentation of Native Natural Enemies:** Evaluate potential for rearing and augmentative release of native natural enemies.
- 3. **Entomopathogenic Fungi:** Test fungal bands, conduct bioassays with selected native or naturalized entomopathogenic fungi.
- 4. **Foreign Exploration of *A. planipennis* Natural Enemies in Asia**

Needs and benefits: By definition, biological control is not consistent with the ultimate goal of *A. planipennis* eradication. Several predators and parasitoids, however, are known to attack native *Agrilus* sp. or other wood-boring beetles in North America. Mortality resulting from native natural enemies has not been quantified but could contribute to reduced *A. planipennis* density and successful eradication. In addition, if eradication is not successful, biological control will become a priority for long-term management and population reduction, and information about Asian natural enemies will be needed.

Suppression Zone Activities:

The suppression zone will be the first zone encircling the core zone. The suppression zone goals include activities that will result in the detection of EAB spread, and containment and removal of populations in a way that will support the overall EAB population reduction, containment, and eradication. It is expected that EAB will spread naturally from areas of high population within the core zone into new healthy ash trees adjacent to the core zone. The suppression zone will be an approximately 3-mile-wide band around the core zone. Surveys within this zone will be conducted at a density level that will identify and monitor the movement of EAB populations and the effectiveness of suppression measures implemented within this zone. Suppression measures may include the mandated removal of ash trees found to be supporting EAB infestations in this zone. Outreach efforts will include communication with property owners on program goals, quarantine restrictions, and proper disposal measures. Disposal of infested trees in this area will support the eradication goal of the program. Additionally, an incentive program that involves a restoration component will be evaluated as a management tool in this zone to reduce ash populations in the suppression zone. Research activities within this zone will include tactics to attract, trap, and kill EAB such as using trap trees, insecticides, and selective host tree removal, and developing a methodology for control and survey. Restoration for mandatory tree removal will also be a part of the suppression zone strategies.

Fire-Break Zone Activities:

The fire-break zone will be the second zone encircling the core zone. This zone will be regulated and maintained EAB-free with the goal of establishment of a 3-mile barrier that will block the natural spread of EAB from known infested areas. This barrier will use vegetative and land use features, along with program activities, to minimize the availability of suitable host and eliminate any EAB establishment in this zone. Survey activities in the fire-break zone will be conducted at a density level that will assure detection of early infestation by EAB. Removal of ash trees found in support of an EAB infestation will follow, and will be mandatory in this zone. Surveys will also determine the effectiveness of control measures implemented in this zone. Other program activities in the fire-break zone may include: selective removal of non-infested host material through incentive programs for property owners to remove or treat trees; treatment of non-infested host trees with insecticides shown to be effective; and EAB trapping and monitoring systems as they are developed and shown effective. Pest populations identified in this zone will be eradicated immediately in order to eliminate EAB establishment. Outreach in this zone will focus on communication with property owners on program goals, quarantine restrictions, proper disposal measures, and measures to build support for compliance. Some degree of research will be conducted in this zone with respect to development of trapping and detection methodology. Restoration will be a component of the mandatory tree removals necessary in this zone, and may be a part of an incentive program to voluntarily remove ash host material in this zone.

Detection Survey Zone Activities:

The detection survey zone is the third zone encircling the core zone. The goal of this zone is to establish an approximately 5-mile perimeter beyond the fire-break zone that is surveyed at a density level sufficient to discover and eradicate all EAB infestations that may breach the fire-break zone. All ash trees supporting an EAB infestation will be removed or treated by methods shown to be effective. The Emerald Ash Borer Michigan Eradication Strategy will include all host material within a scientifically determined distance from the infested trees, and may be modified for cause. Ash trees within 1 km (0.6 miles) of an infestation will be intensively surveyed for at least three additional years to ensure the infestation was successfully contained and eradicated. Initially, infested trees will be visually identified based on signs and symptoms such as any life stage, D-shaped holes, vertical-splitting bark, and serpentine galleries. In time, other survey techniques may become available and will be incorporated as appropriate. Outreach in this zone will be consistent with that of the suppression and fire-break zone goals. Restoration will be a component of the mandatory tree removals necessary in this zone, and may be a part of an incentive program to voluntarily remove ash host material in this zone as well.

Targeted Survey Zone Activities:

The targeted survey zone consists of the area within 150 miles of other EAB program activities, and lies outside of all other zones. The goal of this zone is to ensure undetected populations of EAB do not exist within the North Central region of the U.S. Initial survey activities have already been conducted to ensure sawmills, nurseries, and landscape material holding areas are not infested with EAB. Survey activities within this zone can be efficiently conducted as part of existing operational programs, and must continue to ensure other pest populations do not exist within the region.

It is anticipated that Emerald Ash Borer will be identified as a high priority target in the current Cooperative Agricultural Pest Survey (CAPS) for exotic woodborers. This pest should also be a high priority target of inspections conducted by state or federal regulatory personnel at nurseries that sell or receive ash, sawmills that receive ash logs, sites or dumps that receive landscaping materials, and other potentially high risk sites. Crews conducting Forest Inventory and Analysis (FIA), Forest Health Monitoring (FHM), or related surveys in forested areas should similarly be trained and asked to watch for Emerald Ash Borer adults or infested ash trees. Ideally, state and federal agencies will adjust the distribution of FHM survey plots to ensure that forest types with a significant ash component falling within the 150-mile Targeted Survey Zone are adequately sampled. Data from surveys in the Targeted Survey Zone, whether negative or positive, should be submitted to a single entity, which could include the CAPS database, the Emerald Ash Borer Eradication Program manager, State Plant Health Regulatory Officials (SPROs), or State Plant Health Directors (SPHDs).

Conclusion:

The successful implementation of this EAB Eradication Strategy will hinge upon several significant factors in support of detection, containment and eradication of EAB. First, research is needed in all areas of EAB biology as it relates to detection, containment, and control options for the EAB response. Refinement of survey methods would be especially beneficial in improving detection capabilities, as the visual survey tools of today are best suited to detect a one-year-old infestation via exit holes and tree decline. New EAB infestations may show little or no visible outward signs thus complicating survey activities at the leading edge of the infestation. In response to the challenge faced by the survey component of the plan, zone management strategies will be implemented to provide the necessary assurance of containment for the eradication effort. Second, in addition to research needs, the size of the EAB infested area will present a challenge of scale for regulatory, survey, data management, disposal, and restoration efforts, all of which will be largely dependent upon budget for their success. The coordination of all agencies and university expertise will provide both the challenge and the basis for successful response to this pest. Funding of this effort will be critical in the protection of the ash resource on this continent.

Budgetary Summary:

To date, a majority of the activities accomplished have been done using the existing budgets of the partnering agencies. Additional activities can not be accomplished without substantial financial support. Major components of an EAB eradication program will be implemented based on individual zone strategies, which are anticipated to be necessary for a period of several years to accomplish the program objectives. It is anticipated that this response plan will require efforts for a period of approximately thirteen years. There is recognition that any EAB eradication program budget will support federal, state, and local eradication efforts, as well as critical research and restoration, in a comprehensive response to the introduction of EAB in North America.

complete development within a single year; a Chinese report indicates that two years are required for development in cold climates. Obviously, this could have great implications for the dynamics of beetle populations, potential spread rates and risks of transporting beetles in ash logs or lumber. The extent of adult feeding on foliage is not yet known. Behavior by feeding adults or preferences for specific aspects, heights or foliage conditions should be evaluated.

Methods for rearing large numbers of healthy beetles in the laboratory would provide scientists with opportunities to work with the beetle outside the infested area and to conduct controlled studies and bioassays in the laboratory. This will require development of a suitable artificial diet. Protocols must also be developed for rearing beetles under field conditions (e.g., using cut bolts).

The potential rate of increase of *A. planipennis* populations cannot be determined without data on potential and realized fecundity, sex ratio and adult longevity, as well as mortality rates. Information on reproductive behavior of adult beetles could also help with efforts to develop effective lures, traps and survey protocols.

D. Host Preference and Suitability:

1. ‡Host Range (*Fraxinus* sp., *Ulmus* sp., *Juglans* sp., and other Oleaceae)
2. ‡Oviposition Preference and Development on Different Ash Species and Horticultural Varieties
3. ‡Influence of Tree Stress on Host Selection by Female Adults and Larval Survival
4. ‡Effects of Aspect, Shade, Tree Size on Host Selection and Larval Survival

Needs and benefits: Information provided by Eduardo Jendek, the identifier of *A. planipennis*, and literature from Japan and Korea, indicate that *A. planipennis* or a closely related species was collected from *Juglans* sp., *Ulmus* sp. and *Pterocarya* sp. in areas of Asia. To date, we have observed *A. planipennis* only on ash, even when *Juglans* sp. and *Ulmus* sp. trees were immediately adjacent to infested ash. Host range of *A. planipennis* should be confirmed, however, with host preference and no-choice tests under field and laboratory conditions.

Host preference and suitability tests are also needed to determine whether green ash is more susceptible (likely to be attacked) or more vulnerable (likely to succumb from attacks) than white or black ash. While the currently infested area in Michigan is dominated by green ash, many white and a few black ash trees within the area have been killed by *A. planipennis*. Variation among ash species in susceptibility or vulnerability would obviously have major implications for *A. planipennis* spread, impact and management. Anecdotal evidence suggests that some horticultural varieties of ash may be more resistant than others, but it is not clear if this is truly differential resistance or if external symptoms of infestation (exit holes, bark splits) are expressed differently on some varieties.

A Chinese report indicates that adult beetles prefer sunny locations or may be more likely to ovipositor on trees growing in the sun. If this pattern also occurs in Michigan, it could be used to refine survey protocols and could affect beetle development, phenology and selection of hosts in urban and forested habitats.

planipennis will likely respond to some semiochemicals. Responses of *A. planipennis* adults to ash volatiles, stress compounds (e.g., ethylene), girdled trees or cut bolts, bark characteristics, foliar color or related cues, and short range contact pheromones must be evaluated. Methods to effectively trap beetles are needed, including traps to passively intercept adults and traps to attract and retain beetles. Compounds such as conifer volatiles that may function as repellents or anti-aggregants could become useful management tools and should be investigated.

Visual identification of recently infested trees is problematic when external symptoms such as adult exit holes, callused galleries, bark splits and canopy dieback are not visible. Determining whether such trees are infested requires that the bark be peeled back to expose the sapwood. This process typically kills or severely disfigures trees and is time and labor-intensive. Data on distribution of new and old galleries collected from trees of varying size will help to determine if there are consistent patterns in the temporal and spatial distribution of *A. planipennis* attacks. Such information can be used to identify optimal locations to search for galleries without requiring complete destruction of trees. Non-destructive methods to efficiently identify newly infested trees will be especially important on the perimeter of the infestation. Methods to detect acoustic emissions of feeding larvae, under development for Asian longhorned beetle (*Anoplophora glabripennis*), have potential application for *A. planipennis* and need to be evaluated.

Remote sensing and aerial photography have much potential for efficiently delimiting *A. planipennis* infestations, identifying concentrations of declining or dying ash, and assessing *A. planipennis* impact over a large scale. These technologies could also help to focus or target ground surveys or trapping efforts, increasing the efficiency and success of these activities. A key consideration, especially at the perimeter of the infestation, will be whether recently infested ash can be identified by a distinct spectral signature before substantial canopy die-back occurs. It is also not clear whether declining, infested ash can be distinguished from declining but uninfested ash.

C. Emerald Ash Borer Biology:

- 1. †**Dispersal Ability:** Acquire information on the typical and potential distance that dispersing adults travel, stimuli for flight, and behavior of dispersing adults.
- 2. ‡**Life Cycle:** Quantify stage-specific phenology and development rates, assess mortality factors and mortality rates of life-stages, and learn more about adult feeding behavior.
- 3. ‡**Rearing:** Develop field and laboratory protocols to rear *A. planipennis*
- 4. **Reproduction:** Determine potential rate of increase of *A. planipennis* populations by quantifying sex ratio, adult longevity, potential and realized fecundity. Assess mating and oviposition behavior.

Needs and benefits: Data on adult dispersal behavior and flight ability must be acquired before we can predict the rate and direction that populations will spread. Information about factors related to flight and dispersal of adult beetles will be critical in developing effective containment or eradication strategies. Average and potential distance or duration of adult flight, and stimuli associated with short- and long-range dispersal must be determined.

The scarcity of information available from Asian countries on *A. planipennis* life history and behavior is remarkable. Basic observations of development rates, phenology, stage-specific mortality rates and causes of mortality are needed to develop effective methods for delimitation, impact and population surveys and for trapping and controlling *A. planipennis*. It is not yet known whether all beetles in Michigan and Ontario will

I. EAB Management Plan: Regulatory Component

The regulatory component supports the eradication effort by assuring that Emerald Ash Borer is not further spread artificially by human activities. In addition, because Emerald Ash Borer is also in Canada, the regulatory program will support and harmonize with Canadian efforts, where possible.

This section provides a general outline of the overall Regulatory Component functions and activities. Because the eradication program has adopted the Science Advisory Panel recommendation to manage EAB within specific zones around the core infestation, the regulatory activities are tailored to meet the goals of these zone management strategies. **A specific description of regulatory activities by zone is included in upcoming sections for each of the five zones.**

A. Regulatory Authorities:

The State of Michigan Emerald Ash Borer Quarantine, promulgated on July 16, 2002, is currently in effect. The boundaries of the Michigan EAB Quarantine are based on the results of intensive delimiting surveys. Six counties in Southeast Michigan are included in the state quarantine: Livingston, Macomb, Monroe, Oakland, Washtenaw and Wayne.

A Federal quarantine, essentially identical in purpose and scope to the State of Michigan Emerald Ash Borer Quarantine, is expected to be in place in the near future.

A Canadian Ministerial Order regulating Essex County, Ontario, went into effect October 15, 2002. A Canadian Quarantine (Directive) is expected in the near future. The Canadian quarantine is expected to parallel the federal and State of Michigan quarantines for Emerald Ash Borer.

B. Regulatory Issue:

The Zone Management approach establishes various zones, several of which are entirely or mostly within the quarantined counties. The strategy of the zone management approach calls for reducing or entirely eliminating EAB infestations within some of these zones. Consequently, it would be counterproductive to allow regulated materials to move into or within all except the core zone. In the near future, probably in conjunction with the federal quarantine, an internal state quarantine will be established to prohibit the movement of regulated articles outside of the core zone.

C. Regulated Articles:

The following articles are currently regulated by the State of Michigan quarantine and the Canadian Ministerial Order. The pending federal quarantine will also include these articles:

- 1. Emerald Ash Borer (Coleoptera, Buprestidae, *Agilus planipennis*) in any living stage of development.
- 2. Ash trees, ash limbs and branches, and cut ash firewood.
- 3. Ash logs or untreated ash lumber with bark attached.
- 4. Uncomposted ash wood chips and uncomposted ash bark chips larger than one inch in diameter.
- 5. Any article, product or means of conveyance when it is determined to present the risk of spread of the Emerald Ash Borer.

D. General Regulatory Activities:

Regulatory activities focus on implementing and enforcing quarantine provisions governing the movement of regulated articles (defined in Section C) that could result in the artificial spread of Emerald Ash Borer. These include the following general activities:

1. Identifying persons and establishments whose business or personal activities could result in the artificial spread of EAB, including spread to areas within the quarantined counties which are part of other Management Zones specified by the Science Advisory Panel. These include:
 - Nurseries
 - Landscapers and garden centers
 - Firewood dealers
 - Logging companies
 - Utility companies
 - Tree removal companies
 - Tree pruning companies
 - Municipalities whose workers remove or trim trees
 - Yard waste removal firms
 - Ash material marshaling yards (allowed only in the Core Zone)
2. Contacting by telephone and personal visits those identified persons or establishments to explain quarantine provisions.
3. Determining if provisions in the quarantine (e.g., treatment or processing) may be applied to allow the person or establishment to move regulated materials out of the quarantined area. If such provisions are applicable, entering into a formal Compliance Agreement with the person or establishment. The Compliance Agreement will stipulate the specific way ash materials must be handled by the person or establishment to meet the provisions of the quarantine.
4. Issuing limited permits (PPQ form 530) to allow movement of regulated articles out of the quarantine area or out of a particular zone within the regulated area to a specific destination for further processing or treatment.
5. Issuing certificates (PPQ form 540) to allow movement of regulated articles out of the quarantine area or out of a particular zone within the regulated area when they have been treated or processed in such a manner that they no longer present a risk of artificially spreading Emerald Ash Borer.
6. Monitoring the activities of those persons or establishments placed under a Compliance Agreement by overseeing treatments or other processes and activities.
7. Conducting or assisting with investigations of suspected violations of the quarantine, as necessary, and administering appropriate enforcement action.
8. Recording information about contacts, visits, and Compliance Agreements, and maintaining a database of persons or establishments affected by the quarantine.
9. Reporting results of regulatory activities to management officials.

expected to be at least somewhat effective in controlling larvae, but the optimal timing and relative efficacy of materials and products must be evaluated. In addition, it is not clear how varying levels of canopy die-back will affect the translocation and efficacy of systemic insecticides.

Insecticides applied as cover sprays to the bark and/or foliage of ash trees when adults are active may be a useful option for controlling *A. planipennis* in some situations. Relative efficacy of products, optimal timing, and application methods must be determined. Insecticide persistence must be considered because adult beetles may be active from mid-May through mid-August. More knowledge about adult feeding and oviposition behavior is needed to develop sound guidelines for cover sprays.

Chipping is expected to be the primary method for disposing of infested ash trees, but data is needed to assess larval, pupal and adult survival in chips of varying size. Timing of chipping and seasonal development of larvae should be considered. For example, larvae that are actively feeding in the cambium just under the bark may be more vulnerable than prepupal larvae that have moved into the bark or wood to overwinter. Effects of exposure to elements, size of chip piles, and heat generated in chip piles (e.g., from composting) may affect *A. planipennis* survival and thus size requirements for chips or the length of time that chips can be held before further processing.

Survival of *A. planipennis* larvae and other life stages in ash logs, debarked logs and lumber needs to be assessed. This information will be needed to develop compliance protocols for harvest, transport and milling of ash logs and lumber.

Firewood presents a major risk of *A. planipennis* transport and introduction into new areas. Firewood is frequently transported from urban areas in southern Michigan to campgrounds, recreation areas and cabins located in forested areas of northern Michigan. Monitoring larval survival in ash bolts over time will help in developing appropriate messages for public education programs, thus enhancing quarantine compliance.

B. EAB Detection, Survey and Monitoring Needs:

1. †**Semiochemicals:** Evaluate ability of host volatiles, pheromones or lures, girdled trees or cut logs to attract adult *A. planipennis*. Identify effective trap designs and protocols for detection, survey and monitoring activities.
2. †**Identification of Newly Infested Trees:**
 - a. Identify methods to efficiently and non-destructively sample newly infested trees that do not yet exhibit die-back, exit holes or other external signs and symptoms of *A. planipennis* infestation.
 - b. Identify spatial and temporal pattern of attacks on small and large trees and the number of years that trees are attacked prior to death.
 - c. Evaluate acoustic emissions or other technology for detecting larvae within trees.
3. †**Remote Sensing and Aerial Reconnaissance:** Develop or refine methods for use of remotely sensed data and aerial photography to distinguish ash from other hardwood species and to identify declining ash. Determine whether spectral signatures of trees infested by *A. planipennis* can be identified and distinguished from trees affected by ash decline or other pests.

Needs and benefits: The ability to attract and trap adult *A. planipennis* is a critical aspect of detection, survey and management activities. Like other *Agrilus* sp. beetles, *A. planipennis* is not expected to produce long distance aggregation or sex pheromones, although this should be confirmed. On the other hand, some *Agrilus* sp. beetles are attracted to volatiles of susceptible hosts and to short-range pheromones, suggesting that *A.*

VII. EAB Management Plan: Research

Information on the biology and ecology of Emerald Ash Borer (*Agrilus planipennis* Fairmaire) in its native range is limited. No guidelines for management or control of this species in China or other countries or origin are known to exist. Research is urgently needed to: (1) improve detection and survey efforts; (2) protect landscape and forest trees; and, (3) develop management strategies to contain the infestation, reduce beetle density and, ultimately, eradicate this pest.

Specific research objectives were identified in August, 2002, by scientists at Michigan State University (MSU), Michigan Technological University (MTU), the USDA Forest Service (FS), and USDA APHIS. The Center for Plant Health Science and Technology (CPHST) will coordinate research activities for this pest. In addition, the national Emerald Ash Borer Science Advisory Panel met in October, 2002, and identified immediate and longer-term research needs that will be vital for the implementation and success of the eradication program.

Here, we outline the research objectives, identify immediate and longer-term research priorities, and briefly summarize the basis for such studies. Symbols associated with specific research objectives refer to items listed as immediate research needs (†) and longer-term research needs (§) by the Emerald Ash Borer Science Advisory Board.

Some studies involving researchers at MSU, FS and CPHST are underway and are noted below. These projects include evaluation of insecticides injected into infested trees, monitoring *A. planipennis* development, phenology and survival in infested trees, cut logs and chips, and evaluating the distribution of attacks within trees. Preliminary work has also begun to assess potential traps and adult beetle attractants, and to determine the origin and rate of spread of the infestation. Personnel from the USDA Forest Service, Northeastern Area Forest Health Protection group (USFS-NA-FHP) is working cooperatively with the MI Department of Natural Resources to develop effective aerial survey methods.

Research Needs:

A. EAB Management in Landscape, Nursery and Forested Settings:

1. †**Insecticides:** Assess product effectiveness and identify optimal timing and application methods for systemic insecticides and bark or foliage sprays. Evaluate relationships among larval feeding, canopy die-back, translocation of systemic products and efficacy.
2. †**Chipping:** Demonstrate effectiveness of chipping to control *A. planipennis*. Factors to consider include type of chipper, chip size, *A. planipennis* life stage, timing of chipping, and exposure and storage of chips.
3. †**Logs and Firewood:** Determine *A. planipennis* survival in barked and debarked ash logs of varying size and in ash firewood; Consider size of ash material, season of cutting, duration of exposure and related factors.

Needs and benefits: There is an immediate need to identify methods to protect valuable shade and ornamental trees, and to develop regulatory treatments to allow export of nursery stock from infested areas. Systemic insecticides that are injected into trees or into the soil for uptake by trees may be used to protect healthy trees from *A. planipennis* infestation, as well as to control larvae in infested trees. If active compounds are translocated to the foliage, systemics may also affect adult beetles during maturation feeding. Systemic products are

E. General Considerations - Ash Tree Disposal Activities:

Within the quarantined area there will be many thousands of dead and dying trees that are or may still be infested with eggs, larvae, or pupae of Emerald Ash Borer. Municipalities, private tree companies, utilities, and private citizens will cut them down because they present a danger of falling, are unsightly, or because they simply want to eliminate a future problem from their landscape. This abundance of cut ash material within the quarantined area presents serious concerns about the artificial spread of EAB. Because of the unique problems presented by the large number of trees being removed, special provisions need to be outlined that deal with regulating sanitation and disposal activities.

Note: The Zone Management Strategy also calls for the removal of substantial numbers of ash trees, both infested and non-infested, as a control measure. The disposal of trees removed as part of control activities is part of the control component of this plan. Regulatory and control personnel will work together to efficiently accomplish sanitation and disposal activities, as necessary.

F. Regulatory Ash Tree Disposal Activities:

The focus of disposal activities will be to locate appropriate marshaling sites and set up a system where municipalities, tree service companies (including those which may be under contract with the Eradication Program), utilities, and individuals can drop off cut ash material which will be further processed and disposed of in a manner to support program objectives to prevent artificial spread.



Designated marshaling locations will be required to meet certain size, security, operational, and accessibility criteria. Processing and disposal activities will be specified and supervised by regulatory personnel and will be consistent with those specified in the quarantine.

The program may contract designated marshaling locations, or they may be provided by municipalities or other entities that have a willingness to participate in the activity. Marshaling locations, processing activities and disposal activities will operate under contract, Memoranda of Understanding, and/or Compliance Agreements to insure that stipulated activities are clear and consequences for noncompliance are known.

As part of good regulatory practices, marshaling yards will only be located within the heavily infested core zone as defined in the Zone Management strategy.

The following general disposal activities will be performed by regulatory personnel:

1. Develop general specifications for marshaling yards, processing activities, and disposal activities.
2. Supervise and monitor the operations of the marshaling yards.
3. Supervise and monitor grinding operations to insure the process produces chips of the proper size.
4. Schedule and supervise the movement of the mobile grinders between the designated sites.

- 5. Schedule and supervise the movement of ground ash to approved disposal sites. This may include issuing permits (PPQ form 530) to truckers.
- 6. Enter into Compliance Agreements with disposal sites to insure that stipulated activities are clear and consequences for noncompliance are known.
- 7. Monitor disposal activities at approved disposal sites. This will include verifying documentation of trucks arriving at the site and insuring that regulated material is handled and disposed of properly.
- 8. Conduct or assist with investigations of suspected violations of specified procedures, as necessary and appropriate.
- 9. Record information about contacts, visits, and Compliance Agreements, and maintain a database of persons or establishments affected by the quarantine.
- 10. Report activities and results on a regular basis to EAB management officials.

G. Contracting for Ash Tree Disposal Activities:

Some or all of the sanitation and disposal facilities or operations and activities may be contracted to private companies. Regulatory personnel will supervise contracted activities. These may include:

- 1. Marshaling yards where unprocessed material is brought for further processing and disposal.
- 2. Grinding operations, which provide machinery (grinders), and personnel to operate them.
- 3. Transportation of cut material, both trees and chips.
- 4. Disposal of processed material at incinerators or composting yards.
- 5. Tree removal as designed by program personnel.

H. Regulatory Investigations and Violations:

If regulated material is found to have been moved out of the regulated area or out of particular zones within the regulated area, regulatory personnel will conduct initial preliminary investigations to determine if a violation of the quarantine has occurred. These investigations will also attempt to identify and to trace the source and destination of any other related shipments of regulated materials that may have occurred.

Preliminary investigations by regulatory personnel will allow management to determine whether the situation warrants additional formal investigation by USDA, APHIS, Investigation and Enforcement Services (IES) personnel. IES personnel have specialized law enforcement training and are authorized to take affidavits and to subpoena records. Formal investigations by IES could result in civil or criminal prosecution.

I. Quarantine Boundaries and Regulatory Incidents:

The initial six-county Emerald Ash Borer quarantine boundaries were established through consultation with the cooperating regulatory agencies on the project. Delimiting survey had established that substantial portions of all six counties were infested with Emerald Ash Borer.

In establishing the boundaries, it was agreed that the county was the smallest political/geographical unit that could be effectively managed over the long term. Consequently, the quarantine implemented by the State of

- 3. State and federal program representatives who can respond to questions about EAB, quarantine restrictions, control measures, and their impact.
- 4. Representatives from cooperating state universities who can answer questions about the biology of EAB, its host range, and potential impact in the U.S.
- 5. County, city, and local cooperators who can respond to questions about their role in the eradication effort.

D. Media and Community Relations:

The outreach component will establish a media and community relations spokesperson to maintain contact with the media (print, radio, television) and involved community groups (Greening of Detroit, SEMCOG, etc.). The spokesperson will develop and maintain close contacts with reporters and community group leaders to provide consistent access to information, and to provide positive insight into the eradication effort.

E. Effects of Zone Strategy on Anticipated Questions and Concerns:

The following list of questions anticipates the main areas of concern of the general public and is reflective of those that the outreach component will need to be able to respond to.

- 1. What does Emerald Ash Borer look like?
- 2. Where did Emerald Ash Borer come from and how did it get here?
- 3. What is the eradication plan and how am I affected?
- 4. If the entire county is infested, why can't firewood be moved to other zones?
- 5. How do I recognize ash trees and symptoms of infestation?
- 6. How do I report an EAB infested tree or an ash that appears sick?
- 7. What treatments are available to protect ash trees and how effective are they?
- 8. What trees are good replacements for my ash trees?
- 9. Will the government replace my dead ash trees?
- 10. Will the government replace ash trees they are removing?
- 11. Will the government cut down ash trees on my property for me?
- 12. What authority does the government have to cut down non-infested trees?
- 13. What authority does the government have to come on my property?
- 14. Will the government treat my trees for me?
- 15. What authority does the government have to treat non-infested trees?

However, under the zone management strategy, the relevance of some of these questions will change in accordance with the program activities being planned for each zone. The answers also may change in accordance with program strategy for the zone. Consequently, outreach information may have to be tailored and zone targeted to be effective. These zone-based differences are highlighted in the plan for each of the zones.

B. General Outreach Activities & Initiatives:

1. Maintain a Web site to provide access to current information on Emerald Ash Borer. Insure links are in place from other related Web sites (municipal, college & university, extension, etc.).
2. Maintain a toll-free Emerald Ash Borer Hotline staffed by trained and knowledgeable personnel who can answer questions about the EAB eradication program; receive and log reports of finds, and respond to complaints.
3. Catalogue and review existing informational material to prevent duplication of effort and to insure consistency.
4. Develop and arrange for broadcast of Public Service Announcements on radio and television.
5. Develop and execute mass notification mailings prior to public meetings.
6. Arrange, moderate and provide presentations and support at public meetings
7. Develop/refine/promote the distribution of brochures, posters, pocket quick reference cards, booklets, key chains, etc., to increase general awareness of EAB.
8. Develop and arrange for publication of news releases for mainstream and ethnic printed mediums.
9. Develop and execute mass notification mailings of tree removal, tree treatment, or survey activities.
10. Follow-up on properties not inspected due to access problems. Continued coordination with survey and disposal operations to assure public awareness of program goals.

C. Public Meetings:

Public meetings will take place where control efforts, such as tree removal or pesticide treatments, will have an impact on the community. These meeting will communicate the overall zone management strategy and the requirements of the specific zone where the community is located. The purpose of these meetings will be to address public concerns and secure community support.

Outreach personnel will coordinate scheduling and facilities, insure that public meeting notifications are posted in appropriate newspapers and other media outlets, and that handouts, fact sheets, informational posters, and other outreach materials are readily available at the meeting. Where possible, outreach personnel will make advance direct mailings to notify residents of the impacted community of the meeting.

Public meetings will include the following:

1. Moderators who can insure the orderly conduct of the meeting and direct questions to the appropriate person(s) for response.
2. Political representatives who are familiar with local concerns.

Michigan fully quarantined all six counties, even though in some cases an area less than the entire county is infested. The pending federal quarantine will also define the quarantined area using the county as its smallest unit.

Although the county is the smallest unit for which a quarantine can be practically managed over the long term, it is recognized that a small, isolated infested site discovered outside of the current quarantine boundaries should not necessarily result in an entire county being quarantined. Small isolated infestations of one tree or a group of trees all related to a single source of infestation are common occurrences in all eradication programs. These isolated infestations are commonly referred to as “*Regulatory Incidents*” and are typically linked to the accidental or illegal movement of regulated articles out of the quarantined area.

The Zone Management Plan for Emerald Ash Borer Eradication establishes a number of zones, which may fall partly or entirely within the quarantined counties. Although parts of these zones are within the quarantined area, some of them are EAB-free zones. When a small or isolated infested site is discovered within any part of these EAB-free zones that fall within the quarantined area,ash resources at the site will be eliminated and handled using the same procedures for a Regulatory Incident just as if the infestation were outside of the quarantined area.

Regulatory incidents will be handled using the following procedures:

1. Action will be taken to eliminate the EAB infestation according to the science-based strategies that are the most current and effective. This action will include the involvement of nearby ash trees in the control and eradication strategies, whether or not those trees exhibit EAB symptoms, as detailed in the follow- ing points. The site in question will be monitored, as necessary, for three complete EAB life cycles. The area around this incident will be regulated, as necessary, for this period.
2. Regulatory/control personnel will insure that infested ash trees are cut down and treated (chipped/ ground). They will insure that the chipped material is incinerated. A formal “notice” document will be developed to document the delivery and receipt of the relevant information to impacted property owners.
3. Ash trees within a science-based distance of EAB influence from a known infested tree will also be cut down and processed as if they were infested, regardless of whether they are showing symptoms of infestation. Removal of surrounding trees is necessary because existing visual survey techniques are generally limited to detecting only trees manifesting D-shaped exit holes or bark splits through which serpentine galleries are visible. When these symptoms are found on a tree, the infestation has been present for one year or more, and it is known that the infestation will have spread, via egg laying, to nearby trees showing no visual symptoms in their first year of infestation.
4. Ash trees determined to be in the potential area of impact may be treated with an appropriate pesticide, if found to be effective, as a precautionary/protective measure or if circumstances permit; the ash trees may also be cut down.
5. Survey/regulatory personnel will survey the ash host trees in a science-based area of impact every year during the three year monitoring period after the above strategies have been instituted.
6. In addition, regulatory/survey personnel will contact all homeowners and businesses within two miles of the infested tree to inform them of the find and attempt to determine its source. A specific interview form will be developed and used for this purpose. All data will be saved in electronic format so that it can be further analyzed.

J. Quality Control for Regulatory Activities:

Regulatory management officials will periodically review the database of visits, contacts, and Compliance Agreements being maintained by regulatory personnel to insure that program standards are being adhered to. A percentage of establishments operating under Compliance Agreements will be audited on a regular basis.

II. EAB Management Plan: Survey Component

The survey component supports the eradication effort by providing accurate and timely information on the location, distribution and movement of Emerald Ash Borer. This information is the basis for many other management decisions. Surveying provides continuous assurances that the quarantine is effective in containing EAB, or, by early detection of isolated infestations, provides the opportunity to eradicate them while they are still of manageable size. In addition, because Emerald Ash Borer is also in Canada, the survey program will support and harmonize with Canadian efforts, where possible.

This section provides a general outline of the overall survey component functions and activities. Because the eradication program has adopted the Science Advisory Panel recommendation to manage EAB within specific zones around the core infestation, survey activities are tailored to meet the goals of these zone management strategies. **A specific description of regulatory activities by zone is included in upcoming sections for each of the five zones.**

A. Authority to Conduct Survey on Private Property:

A substantial amount of the survey will be conducted on private property. Surveyors will ask permission and seek cooperation to conduct survey activities on private property. The expectation is that most property owners will cooperate. However, in the event that property owners do not cooperate, the State of Michigan has authority to enter onto private property under Public Act 189 when the presence of a plant pest is suspected. Both state and federal personnel will use this authority as they carry out survey actions in the various zones.

B. General Survey Activities:

- 1. Developing manuals and other aids for use as training or field reference guides.
- 2. Planning, prioritizing, and insuring equipment and supplies are available for survey activities.
- 3. Conducting detection and delimiting surveys using techniques and protocols specified for each of the management zones.
- 4. Developing or adapting existing survey protocols to meet new or unusual program needs.
- 5. Assisting researchers with the testing of new or improved survey protocols.
- 6. Following procedures for reporting new infestations and prompt specimen identification.
- 7. Maintaining survey records and maps and the computerized data base.
- 8. Reporting survey results to management officials and NAPIS in a timely fashion.

Examples of restoration activities linked to data management are: results of survey activities that trigger tree removals; private sector tree replacement contracts; oversight and tracking for large and small scale tree planting activities; and, transfer of tree inventory data to municipalities that take over maintenance of public property restoration efforts.

VI. EAB Management Plan: Outreach and Education Component

The public outreach component supports the Emerald Ash Borer eradication effort by providing information that increases public awareness, understanding, and support for the program. Increased public awareness and understanding enhances the effectiveness of detection survey efforts, helps to prevent adverse public reaction to control efforts, and promotes compliance with regulations. In addition, because Emerald Ash Borer also exists in Canada, the outreach program will support and harmonize with Canadian efforts ,where possible.

This section provides a general outline of the overall outreach and education component functions and activities. Because the eradication program has adopted the Science Advisory Panel recommendation to manage EAB within specific zones around the core infestation, outreach activities are tailored to meet the goals of these zone management strategies. **A specific description of regulatory activities by zone is included in upcoming sections for each of the five zones.**

A. General Outreach Objectives:

- 1. Coordinate outreach efforts among cooperators to insure the program has a consistent message.

The outreach component will provide a single point of contact to work cooperatively with federal, state, and local authorities, the National Plant Board, industry groups, community groups, and others, to establish and convey a consistent message and to insure its delivery is not redundant and is cost efficient.

- 2. Develop outreach materials to meet various program needs.

The outreach component will work with program managers to identify areas or activities where outreach materials are needed and develop informational materials to meet those needs. These include:

- Materials tailored to specific audiences, such as nurseries, firewood businesses, farmers, campers, or ethnic groups needing translation services.
- Materials for specific program activities, such as advance notification of public meetings survey activities, tree removal or tree treatment activities.
- Materials tailored to specific media types: television, radio, news print, public distribution.

- 3. Deliver outreach materials through a variety of outlets to ensure widest exposure.

The outreach component will develop strategies to deliver information through a variety of media types, retail outlets, and community events, to reach the widest possible audiences in a timely and cost-efficient manner (e.g., newspapers, television, radio, Internet, at county fairs, in camping stores, by direct mail, door-to-door distribution (door hangers), etc.).

Examples of control activities that involve data management are: reports of the location of scheduled ash tree treatments or removals; reports of various notifications to property owners regarding control activities; reports related to private contractors; and, records of control treatments.

Control personnel will use the database to record specific data related to tree removal or pesticide treatment to include:

1. Date and time of activity
2. Type of activity (tree removal, pesticide treatment, etc.)
3. If treatment, type performed and chemical used (Mauget, soil treatment, bark spray, etc.)
4. If treatment, amount of chemical applied
5. Location of host material street address and GPS coordinates
6. DBH of the tree
7. Property owner name address, and phone number
8. Contractor name conducting the treatment or removal
9. Temperature
10. Weather conditions
11. Name of inspector supervising treatment
12. All required pesticide application information per state laws and regulations

D. Data Management for Outreach and Education Activities:

The ability of outreach and education to support EAB eradication will depend heavily on access to current, accurate information on the location of EAB, current regulations on movement of ash within the EAB quarantine and within the Firebreak and Detection Survey zones. In addition, a working public reporting system to help identify possible outbreaks of EAB outside quarantine boundaries will be maintained.

Examples of outreach and education activities linked to data management are: the operation and maintenance of the EAB Hotline; operation and maintenance of an EAB Web site for consumers and industry; and, maintenance of various listserves of parties with common responsibilities in the EAB eradication effort. A successful communication strategy will help prevent artificial spread of EAB by uninformed parties, and internally, will promote efficiency of the overall operation.

E. Data Management for Research Activities:

The research component of the EAB eradication strategy will utilize numerous independent data management systems required for the success of the numerous individual research activities necessary to fill information gaps in the areas such as biology of EAB, control options, host information, and others. The data management activities of the research component of the EAB eradication strategy will include the identification and distribution of research in priority areas, followed by the cataloging and distribution of completed research.

F. Data Management for Restoration Activities:

Restoration is an important component of the overall EAB eradication strategy, when it follows mandatory tree removals and as an incentive strategy in areas where voluntary removal of ash is promoted to protect barriers in zone management strategies. In addition, where restoration is part of large scale planting projects there will be a need to track, maintain inventory data, and support audit needs of funding entities as the restoration occurs. Longer term data management will remain a requirement for trees planted on public property.

C. General Survey Methods and Procedures:

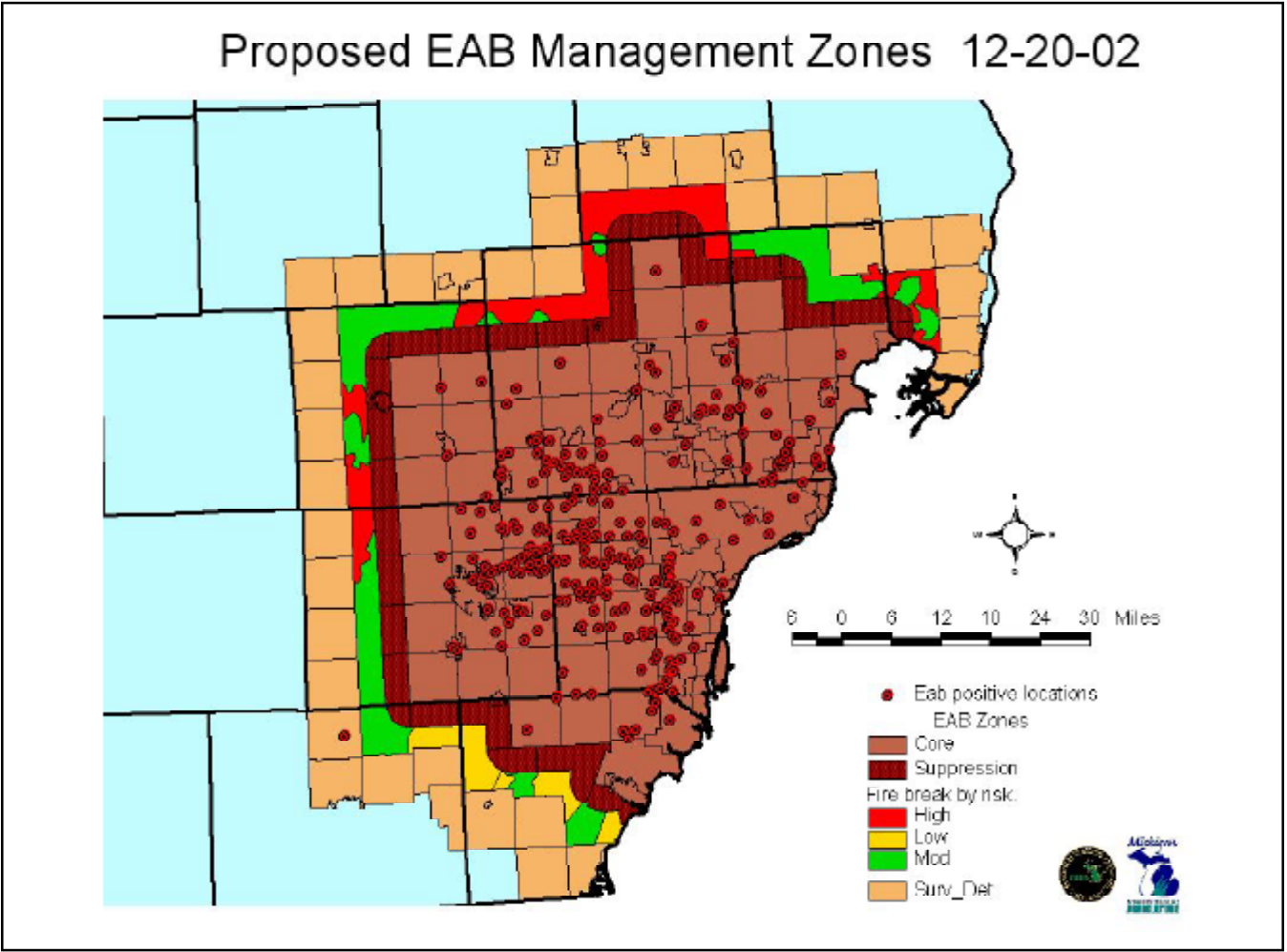
Initially, EAB survey methodology and procedures will be limited to visual detection of infested trees. Survey areas will be defined by using various sizes of survey grids or other survey units. Survey sites will be identified in each grid square or survey unit and individual tree inspections will be conducted by examining trees for EAB symptoms such as thinning crowns, dead branches, basal sprouting, bark cracks, serpentine larval galleries, and D-shaped exit holes.

Where more intensive survey is needed, asymptotic ash trees will be examined using destructive techniques, which require peeling off bark to inspect for developing EAB larvae. In areas where a high degree of certainty is needed, protocols for the number of trees that need to be examined will be developed using statistical models.

As research efforts suggest more efficient survey tools (e.g., traps baited with aromatics or pheromones or acoustic devices to detect larval movement), they will be assessed by survey personnel as to their degree of improvement over visual techniques. Those which are proven effective will be brought into use.

D. Quality Control for Survey Activities:

Survey activities will be subjected to quality control monitoring by supervisory personnel. Quality control techniques will include resurvey of a percentage of the sites, analysis of survey data submitted for consistency, and direct observations.



III. EAB Management Plan: Zone Management Strategies

The zones discussed in this section are depicted on the following map, based upon available data as of December 20, 2002.

Core Zone Strategies: The Core Zone is the epicenter of the Emerald Ash Borer infestation. It is that geographical area shown to be heavily infested through survey activities. In establishing the Core Zone, a buffer of three miles from the last known infested tree is added to the area to account for infestations that might not yet be detected. The Core Area is completely within the quarantined counties.

A. Science Advisory Panel Goal:

Allow EAB populations to exhaust their food resource within the heavily infested Core Zone. When food resources are exhausted, the EAB population will collapse.

B. General Regulatory Activities to be performed in the Core Zone:

The general activities that regulatory personnel will perform in the Core Zone are those specified in this plan under “I. EAB Management Plan: Regulatory Component”.

Regulatory personnel will have additional responsibilities to insure that regulated items do not move out from the Core Zone into the Suppression, Fire-break or the Survey Detection Zones wherever these zones fall inside of the quarantined counties. This will be facilitated by an internal quarantine written to prohibit movement of regulated ash material out of the Core Zone.

C. Disposal Activities in the Core Zone:

The sanitation and disposal tasks that regulatory personnel will perform in the Core Zone are those specified in this plan under “I. EAB Management Plan: Regulatory Component.”

As part of good regulatory practices, all marshaling yards for disposal activities will be located within the Core Zone. As necessary, marshaling yards located in the Core Zone will support tree removal control activities or general host removal activities that take place in outer zones.

The number of marshaling yards to be established in the Core Zone to accommodate disposal needs will be based upon the results of the 2003 pilot disposal project that will be undertaken to determine the feasibility and structure necessary to effect the intended regulatory goals of the plan.

D. Survey Objectives in the Core Zone:

Survey activities in the Core Zone have three main objectives:

1. Estimate and quantify tree mortality. This information is needed to validate management assumptions about the pest’s behavior and biology to support activities in other zones.
2. Confirm EAB ash host specificity or detect new hosts. A central premise of the eradication strategy is that ash is the only host for Emerald Ash Borer. This premise needs verification.

5. Phone, fax, e-mail of establishment
6. Type of business
7. Compliance Agreement number (if applicable)
8. Actions taken/needed.
9. Other information as needed for specific zones, as defined by the Zone Management Strategy.

Regulatory personnel will make weekly status reports to EAB management officials summarizing their activities and highlighting immediate or developing problems.

B. Data Management for Survey Activities:

The survey program will establish a computerized database for survey data from all zones. All data collected by survey crews will be submitted daily. The greatest possible use will be made of electronic data collection devices in the field such as hand-held or laptop computers to promote speed and accuracy in submitting data.

Examples of survey activities that involve data management are: reports of the location and results of ash tree inspections of individual survey plots in all zones; reports of the results of EAB inspections of non-ash species; reports of various notifications to property owners regarding response actions triggered by survey findings; and, reports that trigger control activities.

Survey personnel will use the database to record or access relevant information such as:

1. Date of visit
2. GPS coordinates of the site
3. Township, section, range location data
4. Number of ash trees surveyed at the site
5. Tree size(s)
6. Infestations status (positive, negative, suspect)
7. Actions taken/needed.
8. Other information as needed for specific zones as defined by the Zone Management Strategy.
9. Surveyor name
10. Name, address, phone number of property owner (when available and needed for program operations)

The database information will be analyzed to look for patterns and trends; to draw conclusions about rate and direction of spread; and for decision-making on tree removal or treatment that may be needed to prevent EAB from penetrating specific areas of concern in the management of zones beyond the core.

Survey personnel will make weekly status reports to EAB management officials summarizing their activities and highlighting immediate or developing problems.

C. Data Management for Control Activities:

The control program will establish a computerized database for control personnel to use. All data related to tree treatment and tree removal will be submitted daily. The greatest possible use will be made of electronic data collection devices in the field, such as laptop computers, to promote speed and accuracy in submitting data.

Data Management Software Requirements:

The core area of EAB infestation is approximately 2,400 square miles at this time. EAB eradication strategies applied to the outer zones at the leading edge of the infestation will involve a large number of survey plots over a large area of land. The scope of the EAB response will call for a working data management component on a very large scale, making electronic data management mandatory for the success of the operation. The software needs of the EAB eradication effort require a platform that is robust, comprehensive, and able to exchange information among all plan components. There must be the ability to transfer data from numerous hardware devices at all levels of activity in the program. Software must be able to map data, and generate maps and overlays, using generated data. The platform must be designed to accommodate complex analytical queries and be able to generate reports necessary to support the program.

Data Management Hardware Requirements:

Hand-held electronic equipment for field level survey and regulatory activities will be mandatory to successfully implement all the EAB eradication strategies. Technology is available in one instrument to record GPS data, and to input survey and program data for transfer to notebook computers at the crew leader level, and to the network data base where program decisions can be made with the data.

Development and Integration of Data:

Steps will be taken to review existing data management systems in use by agencies responding to other invasive species such as Asian Longhorn Beetle and the Gypsy Moth Slow the Spread program. An evaluation of those systems will precede the development of an information management system for EAB to determine their strengths and applicability to meet the needs of the EAB response. New technology will be reviewed closely to identify hardware and software that can be instituted immediately, and expanded with the program. It is recognized that initial needs of the EAB response will involve independent data retention systems within specific agencies for ongoing program needs, however the goal is to migrate to an integrated information management system that is linked for efficiency, accuracy, and analysis as necessary. Externally, there will be a need and a benefit from providing outside access to the components of the data that relate to pest distribution, biology, controls, quarantine regulations, and the like.

A. Data Management for Regulatory Activities:

The regulatory program will establish a computerized database and an information management protocol for regulatory personnel to use. All data related to regulatory activities will be submitted daily. The greatest possible use will be made of electronic data collection devices in the field, such as hand-held computers and laptop computers, to promote speed and accuracy in submitting data. To the greatest degree possible, the field generated data will be downloaded and linked to GIS management systems that will further define property locations, ownership, and other necessary data, thus minimizing the complexity of data entry in the field.

Examples of regulatory activities that involve data management are: reports of inspections of regulated entities; regulatory directives to parties subject to quarantine; inspections which result in a survey activity; and, ash tree removal or treatment activity.

Regulatory personnel will be involved with data elements such as:

1. Date of visit
2. Purpose of visit (routine, investigation, monitoring)
3. GPS coordinates of the business site
4. Name and address of person or establishment contacted

3. Detect and determine if EAB-resistant ash exists. If resistant ash strains are identified, these may provide germplasm for plant breeders.

E. Survey Methodology in the Core Zone:

Survey methodology in the Core Zone will utilize visual techniques and methodology as specified in this plan under “II. EAB Management Plan: Survey Component.”

Confirmation of infestations in the Core Zone are not dependent upon finding an Emerald Ash Borer life stage in the tree. Because the area is known to be generally infested and because no control activities will be conducted in the Core Zone, the presence of D-shaped emergence holes in an ash tree will be considered sufficient evidence that a tree is infested for the purpose of meeting survey objectives.

F. Survey Protocols for the Core Zone:

To estimate and quantify tree mortality rate and detect resistant ash, a systematic visual survey will be conducted using a one-mile grid overlay of the Core Zone. There will be one survey site per grid. A site is defined as a single ash tree or a grouping of ash trees within 50 yards of each other. One site per one square mile will require 2,419 survey sites based upon the 2,419-square-mile size of the Core Zone.

To confirm host specificity, at each survey site one or two non-ash trees proximal to the targeted ash host trees will be visually examined. Non-host trees exhibiting D-shaped emergence holes will be identified as suspect alternate hosts. Program supervisors using bark-peeling techniques will make confirmation of non-ash host infestations. This information will supplement research activities that are under consideration to confirm host specificity through laboratory studies.

Survey sites will be visited at least one time between July 15 through September 30 (about 10 weeks). During this survey period, ash in general and declining ash in particular will be the easiest to identify, allowing surveyors to make most efficient use of their time.

Surveyors will survey at the same site in successive years in order to gather data about the progress of the infestation. However, as the infestation progresses in the Core Zone and ash trees are removed or die, survey sites used in previous years will disappear. Surveyors will capture this information and then find another site in the survey grid. The consequence of this will be that new site selection will always be a component of survey in the Core Zone.

G. Control Objective and Activities in the Core Zone:

Until eradication objectives in other zones are met, there is no plan to suppress, manage, or attempt to eliminate the EAB infestation in the Core Zone. Consequently, there are no control activities planned in the Core Zone at program initiation.

H. Public Outreach Objectives in the Core Zone:

- Emphasize:
- Prohibitions against movement of firewood.
 - Methods to dispose of cut ash material.
 - Recommended replacement trees.
 - Location and role of survey crews.

- De-emphasize:
- Reporting sick or infested ash.

I. Restoration in the Core Zone:

The Core Zone will experience the greatest loss of ash tree canopy, and as such, it will experience the removal of large numbers of dead and dying ash trees through the efforts of municipalities and private property owners. In this zone, there will be a need to implement a restoration program to restore a healthy, diverse tree canopy in the Core Zone. Additional information on restoration activities is contained in the “*Restoration*” section.

Suppression Zone Strategies: The geographical area that abuts the Core Zone on one side and extends to the Fire Break Zone on the other. The area is actually defined as the area between the Core Zone and the Fire Break Zone.

A. Science Advisory Panel Goal:

Reduce EAB population density in a zone that is a minimum of three miles wide to ensure the integrity of the adjacent Fire Break Zone. This zone will function as a population sink for beetles moving out of the Core Zone.

B. Regulatory Activities in the Suppression Zone:

The general tasks that regulatory personnel will perform in the Suppression Zone are those specified in this plan under “*I. EAB Management Plan: Regulatory Component.*”

Regulatory personnel will have additional responsibilities to insure that regulated items do not move out from the Suppression Zone into the Fire Break or the Survey Detection Zones even though these zones may be within the quarantined counties. This will be facilitated by an internal quarantine written to prohibit movement of regulated ash material out of the Core Zone.

C. Survey Objectives in the Suppression Zone:

Survey activities in the Suppression Zone are conducted to support the Suppression Zone strategy of EAB population reduction (suppression) to reduce pressure on the Fire Break Zone. To support the suppression strategy, survey activities in the Suppression Zone have two objectives:

E. Procedures for Pesticide Treatments:

1. Authority to apply pesticides to trees on public and private property:

State and federal laws governing the authority to enter and apply pesticides on public and private property will be reviewed and such actions will be in keeping with the authorities prescribed by statute.
2. Identification of Trees and Notification to Property Owner:

When individual trees are to be treated at a specific site, control personnel will identify the trees selected for pesticide treatments by marking the trunk with non-permanent paint. A sketch map of the area showing the trees in relation to fixed reference points will be drawn. GPS coordinates for each tree to be treated will be recorded on the map. Property owners will be provided written notice either by mail or by direct delivery, which provides the explanation for the action and a contact number where further information can be obtained. In addition to being provided with written notice, property owners will also be notified orally, where possible. Every effort must be taken to assure owners are informed of actions before trees are treated.
3. Timing of Pesticide Applications:
Pesticides used will be applied according to label recommendations and as prescribed by a land grand university authorized to develop recommendations.
4. Contracting for Pesticide Applications:

Pesticide applications may be contracted to private companies by the eradication program. Companies under contract with APHIS or the State of Michigan for this purpose will be properly licensed and certified and will apply pesticides under the supervision of regulatory or survey program personnel. Contract specifications will include licensing requirements and application procedures in accordance with labeling and eradication program requirements.

V. EAB Management Plan:
Data Management Component

As the overall EAB National Eradication Strategy takes shape and grows, so too will the data management requirements. Each plan component has individual data needs. However, the development of data management strategies will recognize and develop the links and relationships that are required between the various components of the plan. For example, data from a survey effort in the Firebreak Zone that identifies an EAB infestation will become data that is part of a control response involving private contractor removals, audits and restoration efforts.

The data management component supports the Emerald Ash Borer eradication effort by insuring that data needed to effectively manage the program is quickly compiled in a consistent format so that it may be used to track program accomplishments and is readily available for analysis.

Location of Data:

In the initial stages of the EAB response, a Southeast Michigan office will be established by USDA APHIS for the purpose of coordinating the implementation of the plan components. The EAB data required of the program will reside in this office, and will be maintained there for immediate program use with the long-term goal of providing access to other involved agencies for their use as well.

4. Contracting for tree removal:

Tree removal will be contracted to private companies by the eradication program. Companies under contract with APHIS or the State of Michigan for this purpose will do the actual tree removal under the supervision of regulatory or survey program personnel. Contract specifications will include requirements for tree chipping and stump removal and disposal in accordance with eradication program requirements.

5. Restoring tree canopy following government ordered tree removals:

Following government ordered tree removals as a control measure to meet EAB eradication strategy objectives, there will be a plan developed to restore tree canopy where the removal of ash occurs in the landscape. In the case where landscape ash trees are ordered to be removed, the owner will be eligible for tree replacement through a program that will result in a diverse healthy forest canopy. It is recognized that there may not be an equivalent tree for tree replacement capability in all situations, however a strategy will be developed in partnership with funding agencies to apply available funds across the impacted areas within the guidelines established. There will be no restoration applied to removal of ash in fencerows, right of ways, ditch banks, etc., nor will restoration apply to woodlot ash tree removals, though salvage operations that are consistent with the EAB eradication objectives may be allowed.

D. General Considerations for Pesticide Treatments:

Two kinds of pesticide treatments may be considered for use in the control component of the plan. They include treatments to eliminate the ash tree itself, and treatments to control the EAB within the ash trees.

Where supported by a zone management strategy, the use of pesticides to chemically kill ash trees would effect their removal as a potential host for EAB. The implementation of this process would require development of a protocol that includes an evaluation of public support, regulatory oversight for the pesticide application, biological validation as effective means of host removal, and possibly a salvage plan to remove the ash at a later time. A restoration component could also be applicable. The advantage of such a system if implemented, could be that of a faster, more efficient means of enhancing an ash free zone to stop the natural spread of EAB.

With respect to the use of pesticides to control EAB, at program initiation, available chemical treatments are not considered effective enough to substitute for tree removal as an eradication measure. Consequently, until the effectiveness of chemical treatments for EAB eradication can be established, they will be considered only for prophylactic or suppressive efforts.

When considering the use of chemical treatments as a regulatory (mandatory) measure for trees to meet program objectives, tree owners should be informed that their chemically treated tree may have to be removed in the future if evidence of the beetle’s presence is discovered.

When making decisions about voluntary prophylactic treatments to ash trees, property owners should always be advised that the cost of current pesticides, the need for regular reapplication, and the uncertainty of their long-term effectiveness may make cost of removing and replanting ash trees a more cost effective approach to their landscape management.

1. Monitor and obtain data about EAB population size and distribution.

The Suppression Zone is expected to become infested with Emerald Ash Borer as beetles disperse into it from the Core Zone. Survey activities are conducted to locate, map, and monitor infested trees to provide information to chart EAB population build-up and directional movement. This information will be used to take make decisions about tree removal or tree treatment activities in the Suppression Zone and with the objective of keeping EAB population size near the Fire Break Zone low. (Note: Survey activities in the Suppression Zone will also contribute information toward Core Zone survey objectives.)

2. Assist with testing & development of new survey methodology and protocols.

Because visual survey is labor intensive, cannot identify infested trees until the second year of infestation, and requires destructive techniques to verify infestations, survey activities will need more efficient and accurate survey techniques. New and experimental survey methodology will be tested and refined in the Suppression Zone. These will include traps baited with aromatics or pheromones, acoustics, aerial photo survey, and other techniques.

D. Survey Methodology in the Suppression Zone:

Survey methodology in the Suppression Zone will utilize visual techniques and methodology as specified in this plan under “II. EAB Management Plan: Survey Component”.

Confirmation of infestations in the Suppression Zone are not dependent upon finding an Emerald Ash Borer life stage in the tree if no control actions are contemplated at the site. D-shaped emergence holes, which are unique and characteristic of EAB in an ash tree, will be considered sufficient evidence of infestation for the purpose of survey objectives in the Suppression Zone.

E. Survey Protocol in the Suppression Zone:

To monitor population size and distribution, a systematic survey will be conducted using a 1/4-mile grid overlay of the Suppression Zone. There will be one site per grid. A site is defined as a single ash tree or a grouping of ash trees within 50 yards of each other. One site per 1/4 mile will require 9,520 survey sites based upon the 595-square-mile size of the Suppression Zone.

Survey sites will be visited a minimum one time per year. Survey activities may continue year-round, weather permitting.

When an infested tree is discovered in a survey grid, surveyors will delimit the site by continuing to survey surrounding trees. Starting from the tree where the infestation is first detected, surveyors will work outward in all directions examining every ash tree until no more trees are discovered with visible symptoms.

Surveyors will survey at the same site in successive years in order to gather data about the progress of the infestation. However, as the infestation progresses in the Suppression Zone and ash trees are removed or die, survey sites used in previous years will disappear. Surveyors will capture this information and then find another site in the survey grid. The consequence of this will be that new site selection will always be a component of survey in the Suppression Zone.

F. Control Objectives in the Suppression Zone

Control activities in the Suppression Zone are conducted to support the zone management strategy of EAB population reduction (suppression) to reduce pressures on the Fire Break Zone. There is no intention to “save” trees in the Suppression Zone. The infestation is expected to spread from the Core Zone into the Suppression Zone. Infested trees in the Suppression Zone are expected to die. The objective is only to keep the populations low and away from the Fire Break Zone.

Control activities in the Suppression Zone are highly dependent upon survey data, which provides the necessary information as to where EAB population pressure is threatening the Fire Break Zone. At program initiation there will be little information from which to base control type actions. Consequently, control activities in the Suppression Zone will be minimal until after the first round of survey in the Suppression Zone has been completed.

G. Control Procedures in the Suppression Zone:

1. Tree Removal:

- a) Selective tree removal will be utilized in the Suppression Zone both to reduce populations size near the Fire Break Zone and to eliminate host pathways that would allow EAB to naturally spread into the Fire Break Zone. Decisions on the need for tree removal at specific sites in the Suppression Zone will be based on the following criteria:
 - distance from the Fire Break Zone
 - ash tree density in the area
 - EAB population size in the area
 - trends, such as rate and direction of EAB spread
 - whether the trees are being removed because they are infested or because they present a high risk pathway for EAB to reach the Fire Break Zone
 - proximity of the trees to farmland, lakes, or other natural barriers to EAB spread
 - practical considerations, such as cost, site accessibility, community support, etc.
 - availability of alternative control options that meet the objectives as effectively
- b) Tree removal activities in the Suppression Zone will take place during the period from approximately September 15 through May 15. During this period, EAB is in the larval or pupal stage of its life cycle.
- c) General tree removal considerations and procedures are outlined in this plan under “IV. EAB Management Plan: Control Component.”

2. Tree Treatment (chemical pesticide treatment):

- a) It is expected that research will provide information on efficacy of various registered pesticides for control of EAB. Selective treatment of infested trees will then be used where tree removal is impossible or impractical and where control measures are needed to prevent population buildup or natural spread of EAB into the Fire Break Zone. Decisions on the need for treatment at specific sites in the Suppression Zone are the same as those for tree removal specified in the section above.

- a) Removal of infested ash host material eliminates larval stages feeding under the bark, thus eliminating all potential for future adult beetle dispersal from the tree and suppressing the populations size.
- b) Removal of non-infested ash host material deprives Emerald Ash Borer of egg laying sites. If enough trees are removed, a barrier to further infestation spread is established.
- c) Emerald Ash Borer has been known to even infest the root flare of ash roots down to the soil line in areas where EAB is present in high numbers. Consequently, and where practical, stump removal of ash host material to a minimum of nine inches below ground level will be considered in areas of concern.
- d) Ash host material that needs to be removed during the EAB adult emergence period may present a risk of adults dispersing while the process is underway. If it is critical that the tree be removed at that time, a bark spray prior to removal may be considered to kill emerging and recently emerged adults, provided public and/or environmental health would not be impacted.

C. Procedures for Tree Removal:

1. Authority to Remove Trees on Private and Public Property:

The State of Michigan has authority to order the removal of ash trees under Public Act 189. Specifically, this act gives the Michigan Department of Agriculture the authority to declare Emerald Ash Borer “host” material a public nuisance and to order its removal. Both state and federal personnel will use this authority as they carry out control actions in the various zones.

2. Identification of Trees and Notification to Property Owner:

Control personnel will identify trees selected for removal by marking the trunk with paint. A sketch map of the area showing the trees in relation to fixed reference points will be drawn. GPS coordinates for each tree to be removed will be recorded on the map wherever it is practical to do so. Property owners will be provided written notice, either by mail or by direct delivery, that provides the explanation for the action and a contact number where more information can be obtained. In addition to written notice, property owners will also be notified orally where possible.

3. Timing of Tree Removal:

- a) Infested ash trees will be removed as soon as possible if they are outside of the quarantined counties or are in those zones designated as EAB free when those zones are inside the quarantined counties.
- b) Infested ash trees in areas where the zone strategy calls for Emerald Ash Borer population suppression rather than eradication may be left standing to act as a “sink” for additional EAB egg laying. However, infested trees left standing for this purpose will be cut down in the fall, winter, or early spring, prior to adult emergence.
- c) Non-infested ash trees being removed for the purpose of eliminating host material may be removed at any time of the year.

2. Treatment of Ash Trees with Pesticides:

Selective treatment of infested trees may be undertaken in certain zones (as defined in the Zone Management Strategies) where tree removal is impractical and where treatment measures are proven effective and appropriate to prevent population build-up. Also, selective treatment may be done on non-infested trees proximal to an infested site in the outer zones as defined in the Zone Management Strategies. There, treatment would be done only after infested trees and those immediately adjacent to neighboring trees have been removed. Control personnel are responsible for supervising and approving the activities of contract personnel who do the actual work.

If efficacious materials are identified, treatments may include:

3. Elimination of Ash Trees as Hosts without Removal:

In wood lots where it is not practical to remove ash trees due to the large number of ash trees and the density of all species of trees at the site, chemical or physical techniques to completely kill the ash while leaving them standing may be utilized. Killing the ash trees but not cutting them down accomplishes the eradication objective of eliminating host material needed by Emerald Ash Borer in a cost-effective and practical manner. Control personnel are responsible for supervising and approving the activities of contract personnel who would do the actual work.

4. Ash Trap Trees or Trap Logs:

Ash trees that are uninfested or lightly infested may be selected to become deliberately damaged in such a way (e.g., girdled) that they attract Emerald Ash Borer adults seeking egg-laying sites. Alternatively, the tree may be cut down and cut into sections, serving the same purpose. After the damaged tree or cut logs have become infested, they are then removed and destroyed, killing the larvae before they can mature into adults. This control measure would be used only in the Suppression Zone.

5. Pesticides Directed at Adult Emerald Ash Borers:

Emerald Ash Borer adults are the reproductive and dispersal life stage of the pest. General pesticides such as Malathion applied from aerial or ground equipment may be used on certain occasions to reduce EAB populations or to prevent further dispersal. Environmental and community considerations will dictate the use of this control measure.

B. General Considerations for Tree Removal as a Control Measure:

Ash trees are the only known host for Emerald Ash Borer. Ash trees provide both food and a breeding site to Emerald Ash Borer. Without the ash host, Emerald Ash Borer can not survive. This fact is central to the Science Advisory Panel’s Zone Management Strategy for Emerald Ash Borer Eradication. Consequently, activities that involve the removal of ash host material are the most effective control measures that can be taken to suppress EAB population size, to prevent further spread, and, ultimately, to eradicate Emerald Ash Borer.

- b) Chemical treatment activities in the Suppression Zone will take place during periods when the specific pesticide being used is most effective. In general, these periods will be in the spring and summer.
- c) General tree treatment considerations and procedures are outlined in this plan under “*IV. EAB Management Plan: Control Component.*”

3. Trap Trees or Trap Logs:

- a) Because the Suppression Zone is infested or expected to become infested, trap trees and trap logs can be used in this zone as control mechanisms to help reduce EAB population size by drawing egg laying EAB to them. Because of they way that they attract Emerald Ash Borer, trap trees and trap logs have only limited value and outright tree removal is preferred. Their use would be limited to areas close to the Core Zone boundary and would be a poor choice as a control mechanism close to the Firebreak boundary.
- b) Trap trees and trap logs must be in place during the summer when adult EAB are mating and laying eggs. Removal and destruction of the trap trees and trap logs would take place during the fall and winter.
- c) General procedures for trap trees and trap logs are outlined in this plan under “*IV. EAB Management Plan: Control Component.*”

H. Public Outreach Objectives in the Suppression Zone:

Emphasize:

- Prohibitions against movement of firewood.
- Ways to dispose of cut ash material.
- Recommended replacement trees.
- Location and role of survey and treatment crews.

Respond to:

- What treatments are available to protect ash trees and how effective are they?
- Will the government treat my trees for me?
- What are good replacements trees for my ash trees?
- Will the government replace my ash trees?
- Will the government cut down my ash trees for me?
- Who will pay, and exactly what will be paid for?

I. Survey Protocols and other considerations for the Suppression Zone:

Use a 1/4-mile grid overlay of the Suppression Zone to find survey sites. There will be one survey site per 1/4-mile grid square. A site is defined a single ash tree or a grouping of ash trees within 50 yards of each other. If multiple ash trees are present, inspect at least two or them. Delimiting survey will examine all (100 percent) of trees in the delimiting area.

One site per 1/4 square mile (16 sites/sq. mi.) will require 9,520 survey sites based upon the 595 square mile size of the Suppression Zone. (Per 2-20-02 Zone Map). It is estimated that an additional 600 survey sites will be delimited (see below).

Survey sites will be visited by survey crews at least one time between May 12 and October 15 (approximately 22 weeks). Survey activities will continue after October 15 to survey additional sites and to delimit “hotspots”.

Firebreak Zone Objectives: The geographical area that abuts the Suppression Zone on its inner boundary and is approximately three miles wide to its outer boundary. The zone boundaries of the Firebreak Zone are drawn such that the natural geographic, vegetative and land-use characteristics contain the least possible ash host material and the overall size of the zone is small enough to be practical from cost and management perspectives.

The Firebreak Zone may be within, outside of, or partially within and partially outside of the quarantined counties.

A. Science Advisory Panel Goal:

Establish and maintain an unsuitable host barrier that is a minimum of three miles wide that will block the spread of EAB out of the area that is known to be infested. Given this goal, the activities in the Firebreak Zone will utilize integrated techniques that are practical, economically viable, and which contribute to the science panel objectives. Specific decisions on management options will be based upon the situations encountered in the operation of the program, and techniques developed from research.

B. Regulatory Activities in the Firebreak Zone:

The general tasks that regulatory personnel will perform in the Firebreak Zone are those specified in this plan under “*I. EAB Management Plan: Regulatory Component.*”

Regulatory personnel will have additional responsibilities to insure that regulated items do not move into the Firebreak Zone even though this zone may be within the quarantined counties.

C. Survey Objectives in the Firebreak Zone:

The objective of survey activities in the Firebreak Zone is the early detection of Emerald Ash Borer infestations, which result from either natural dispersal from the Suppression Zone or artificial spread through human activities.

D. Survey Methodology in the Firebreak Zone:

Survey methodology in the Firebreak Zone will utilize visual techniques and methodology as specified in this plan under “*II. EAB Management Plan: Survey Component.*”

Confirmations of infestations in the Firebreak Zone are dependent upon finding an Emerald Ash Borer life stage in the tree. D-shaped emergence holes, which are unique and characteristic of EAB in an ash tree, will be considered sufficient evidence of possible infestation to utilize destructive techniques, such as bark peeling, to search for EAB larvae. The capture of adult beetles on or near the tree will also confirm an infestation.

E. Survey protocols in the Targeted Survey Zone:

Because of the “targeted” nature of the activities in the Targeted Survey Zone, regulatory, survey, and control activities are complementary and largely indistinguishable activities, and, consequently, are combined functions. As part of their regulatory activities, assigned personnel will have identified and contacted targeted establishments. As part of their survey activities, assigned personnel will survey all ash trees within the premises of the targeted establishment and will extend their survey outward to include all ash host trees within a 1/8-mile radius.

F. Control Activities in the Targeted Survey Zone:

The finding of an infested ash tree by regulatory/survey personnel in the Targeted Survey Zone will initially be considered a Regulatory Incident. Procedures for handling a Regulatory Incident are given in this plan under “*I. EAB Management Plan: Regulatory Component, section I*”.

G. Public Outreach Objectives in the Targeted Survey Zone:

- Emphasize:
- How to recognize ash trees and symptoms of infestation.
 - How to report an EAB infested tree or an ash, which appears sick.
 - The need and use of Compliance Agreements for any regulated articles coming from the quarantined area.

- Respond to:
- Does the government have the authority to cut down or treat my trees?
 - Will the government replace the infested ash trees they are removing?
 - What authority does the government have to come on my property?

IV. EAB Management Plan: Control Component

The control component supports the eradication effort by suppressing Emerald Ash Borer populations or by completely eliminating small Emerald Ash Borer infestations. In addition, because Emerald Ash Borer also exists in Canada, the control program will support and harmonize with Canadian efforts, where possible.

This section provides a general outline of the overall control component functions and activities. Because the eradication program has adopted the Science Advisory Panel recommendation to manage EAB within specific zones around the core infestation, control activities are tailored to meet the goals of these zone management strategies. **A specific description of regulatory activities by zone is included in upcoming sections for each of the five zones.**

A. General Control Techniques:

1. Removal of ash trees:

Both infested and non-infested ash trees may be removed as a control measure, depending upon the circumstances and the zone. Control personnel are responsible for supervising and approving the activities of contract personnel who do the actual work and of insuring that the disposal of the cut material is handled in an approved manner.

G. Public Outreach Objectives in the Detection Survey Zone:

Emphasize:

- How to recognize ash trees and symptoms of infestation.
- How to report an EAB infested tree or an ash that exhibits symptoms of EAB.
- Location and role of survey and or treatment crews.

Respond to:

- Does the government have the authority to cut down or treat my trees?
- Will the government replace the infested ash trees they are removing?
- What authority does the government have to come on my property?

Targeted Survey Zone Objectives: The geographical area which adjoins the Detection Survey Zone and extends outward for approximately 150 miles. Establishments in the Targeted Survey Zone which deal in ash materials (sawmills, nurseries, etc.) will be identified and surveyed regularly for the purpose of insuring that undetected populations of EAB do not exist outside of the quarantined area.

A. Science Advisory Panel Goal:

Ensure that other large, undetected populations of EAB do not exist within the region.

B. Regulatory Activities in the Targeted Survey Zone:

Because of the “targeted” nature of the activities in the Targeted Survey Zone, regulatory, survey, and control activities are complementary and largely indistinguishable activities, and, consequently, are combined functions. The general regulatory tasks are given in this plan under “*I. EAB Management Plan: Regulatory Component.*”

C. Survey Objectives in the Targeted Survey Zone:

The objective of survey in the Targeted Survey Zone is to provide assurances that regulatory activities to prevent the artificial spread of EAB are effective and to detect isolated infestations caused by the movement of regulated articles that may have occurred prior to quarantine implementation.

D. Survey Methodology in the Targeted Survey Zone:

Survey methodology in the Targeted Survey Zone will utilize visual techniques and methodology as specified in this plan under “*II. EAB Management Plan: Survey Component.*”

Confirmation of infestations in the Targeted Survey Zone is dependent upon finding an Emerald Ash Borer life stage in the tree. D-shaped emergence holes, which are unique and characteristic of EAB in an ash tree, will be considered sufficient evidence of possible infestation to utilize destructive techniques, such as bark peeling, to search for EAB larvae. The capture of adult beetles on or near the tree will also confirm an infestation.

E. Survey Protocols in the Firebreak Zone:

Alan J. Sawyer, Ecologist, USDA-APHIS-PPQ, Otis Pest Survey, Detection & Exclusion Laboratory, has developed a survey protocol to detect any infestation greater than 20 trees with 95 percent accuracy. This represents an option for a survey protocol that can be used for the Firebreak Zone. The specifics of the protocol are included as an attachment. Survey protocols will be revised as relevant information becomes available.

However, at program initiation, there will be only limited survey data from which to verify the presumed EAB free status of the Firebreak Zone and consequently to verify that the Firebreak Zone is geographically established in the correct position relative to the leading edge of the EAB core infestation.

Consequently, during the first year, a survey protocol to meet the following objectives will be used:

- 1) The protocol will provide a high, though qualified, degree of assurance that EAB infestations in the Firebreak Zone will be detected.
- 2) The protocol will gather a large amount of survey data for the entire zone in a relatively short period.
- 3) The protocol will allow for rapid implementation of survey activities and will require fewer resources than the statistical model proposed by Alan Sawyer.

Under the first year survey protocol, artificial spread is considered high risk and natural spread is considered low risk. Destinations for artificial spread are identified and ash trees at and near these destinations will be intensively surveyed. All other areas in the Firebreak Zone will be surveyed at a much lower rate.

High risk areas are places where possibly EAB infested nursery stock, firewood, or foreign origin crating may have been delivered. These locations are identified below. These also represent the survey units.

- rural residences (1/8-mi. radius)
- farm residences (1/8-mi. radius)
- lakeside cottages (1/8-mi. radius)
- suburban areas (as a survey unit)
- urban areas (as a survey unit)
- Landscape nurseries outside of urban and suburban areas. (1/8-mi. radius)
- Parks and recreation areas where camping or campfires are permitted. (Vehicle accessible areas + 1/8-mile radius).

For high risk destinations, 100 percent of all ash trees with a diameter greater than 1.5 inches DBH within the survey unit will be checked using visual protocols as specified in this plan under “*II. EAB Management Plan: Survey Component.*”

Aerial and road maps will be obtained and used to pre-plan high risk survey. In particular, aerial maps should help to identify rural and farm residences, lakeside cottages, and forest canopy in proximity to the survey area. Suburban and urban areas will require pre-notification activities so that surveyors are not delayed in examining backyard trees.

Low risk areas are all areas greater than 1/8 mile away from the high risk destinations listed above. For low risk destinations, a survey grid of 1/8 mile will be overlaid on the Firebreak Zone. Each grid is considered a survey unit. One tree or a group of trees within 50 yards will be surveyed in each 1/8-mile grid block using visual protocols as specified in this plan under “*II. EAB Management Plan: Survey Component.*”

If an infested tree is discovered at any survey site, procedures outlined in this plan under “*I. EAB Management Plan: Regulatory Component*” for a Regulatory Incident will be used.

F. Control Objectives in the Fire Break Zone:

The management strategy is to maintain the Firebreak Zone free of EAB. To achieve this, the control program has three objectives in the Firebreak Zone:

- 1. Eradicate infestations by removing and treating trees.

The control program will remove and/or treat ash trees in response to the discovery of small, isolated infestations of EAB in the Firebreak Zone. Discovery of infested trees in the Firebreak Zone will be treated as Regulatory Incidents. Section “I” in this plan under “*I. EAB Management Plan: Regulatory Component*” provides the procedures to be followed for Regulatory Incidents.

- 2. Reduce ash host tree numbers by removing trees.

Program objectives call for the removal of ash host material wherever possible to help establish the Firebreak Zone as a host-free barrier to prevent the natural spread of EAB out of the Suppression Zone. Examples of this strategy include identifying opportunities and facilitating removal of uninfested trees along highways railroad right of ways, and wherever municipalities and property owners are willing to cooperate with this activity.

- 3. Remove or treat trees in response to EAB population build up in the Suppression Zone:

To maintain the EAB free status of the Firebreak Zone, program objectives include the removal and/or treatment of ash host material in the Firebreak Zone in response to population build up and directional trends of EAB in the Suppression Zone.

G. Control Procedures in the Firebreak Zone:

General tree removal and tree treatment considerations and procedures are outlined in this plan under “*IV. EAB Management Plan: Control Component.*”

H. Public Outreach Objectives in the Firebreak Zone:

Emphasize:

- How to recognize ash trees and symptoms of infestation.
- How to report an EAB infested tree or an ash which appears sick.
- Location and role of survey and or treatment crews.

Respond to:

- Will the government replace ash trees they are removing?
- What authority does the government have to cut down or treat non-infested trees?
- What authority does the government have to come on my property?

Detection Survey Zone Objectives: The geographical area which adjoins the Firebreak Zone on its inner boundary and is approximately five miles wide to its outer boundary. This area serves as a check of the integrity of the Firebreak Zone.

A. Science Advisory Panel Goal:

Discover and eradicate all EAB infestations that have breached the Firebreak Zone.

B. Regulatory Activities in the Detection Survey Zone:

The general tasks that regulatory personnel will perform in the Detection Survey Zone are those specified in this plan under “*I. EAB Management Plan: Regulatory Component.*”

Regulatory personnel will have additional responsibilities to insure that regulated items do not move into the Survey Detection Zone even though all or part of this zone may be within the quarantined counties.

C. Survey Objective in the Detection Survey Zone:

The objective of survey activities in the Detection Survey Zone is the early detection of small isolated Emerald Ash Borer infestations. Survey in the Detection Survey Zone provides continuous assurances that activities in the inner zones are effective in containing EAB and, by early detection of isolated infestations, provides the ability to eradicate them while they are still of manageable size.

D. Survey Methodology in the Detection Survey Zone:

Survey methodology in the Detection Survey Zone will utilize visual techniques and methodology as specified in this plan under “*II. EAB Management Plan: Survey Component.*”

Confirmation of infestations in the Detection Survey Zone is dependent upon finding an Emerald Ash Borer life stage in the tree. D-shaped emergence holes, which are unique and characteristic of EAB in an ash tree, will be considered sufficient evidence of possible infestation to utilize destructive techniques, such as bark peeling, to search for EAB larvae. The capture of adult beetles on or near the tree will also confirm an infestation.

E. Survey Protocols in the Detection Survey Zone:

Survey protocols in the Detection Survey Zone are the same as in the Firebreak Zone.

F. Control Activities in the Detection Survey Zone:

Control activities in the Detection Survey Zone are limited to responses to discoveries of infested trees. These will be the same responses as those for Regulatory Incidents. Section I in this plan, under “*I. EAB Management Plan: Regulatory Component,*” provides the procedures to be followed for Regulatory Incidents.